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FALL-SOWN GRAINS

IN MARYLAND AND VIRGINIA

FOR THE BEST RESULTS, fall-sown grains in Maryland, Delaware, and the Virginias require—

A well-drained, fertile soil, well supplied with humus and lime.

An abundance of available plant food, supplied by the use of stable manure, green crops turned under, and commercial fertilizers.

A rotation which includes at least one cultivated crop and one or more legumes.

A seed bed with the surface 2 or 3 inches loose and finely pulverized, while the soil just beneath is firm and moist.

Good, pure, cleaned, and graded seed which has been treated for smut, sown with a drill at the proper time and rate.

Varieties which are adapted to the locality and which produce high yields of grain of good quality. The best varieties are listed on page 20.

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FALL-SOWN GRAINS IN MARYLAND AND VIRGINIA

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CONTENTS

INTRODUCTION

METHODS AND PRACTICES relative to the growing of fall-sown grains in Maryland and Virginia are discussed in this bulletin. Although the statements made are based largely on experiments conducted in these two States, they are applicable over a somewhat wider area. The four States to which they particularly apply are Delaware, Maryland, Virginia, and West Virginia, constituting the northern portion of the South Atlantic group of States. Recommendations are also made as to the best varieties of the various grains to grow.

With the exception of wheat, the small grains are not important crops in these States. The average acreages of wheat, oats, barley, and rye in each State for the 10 years from 1911 to 1920, inclusive, with the acreage of corn for the same period for comparison, are shown in Table 1.

TABLE 1.—*Average acreage of corn, wheat, oats, barley, and rye in Delaware, Maryland, Virginia, and West Virginia for the 10-year period 1911 to 1920, inclusive*

State	Corn	Wheat	Oats	Barley	Rye
Delaware	201,000	120,000	4,600	----------	1,700
Maryland	673,900	638,300	47,600	4,900	24,100
Virginia	1,953,800	961,300	198,800	11,000	61,400
West Virginia	718,600	276,100	136,600	----------	17,100

As shown by Table 1, wheat is an important crop in each of the four States, though in every case the acreage is smaller than that of corn. The average wheat acreage in Delaware for the 10 years

from 1911 to 1920, inclusive, is a little more than one-sixth (18.4 per cent) of the improved farm land in the State as recorded in the census of 1920. In Maryland it is 20.3 per cent of the acreage of improved farm land, being only slightly smaller than the corn acreage. In Virginia only about 1 acre of improved land in 10 is sown to wheat, the percentage being 10.1, whereas in West Virginia only 5 per cent of the improved farm land is devoted to this crop.

None of the other grain crops occupies more than 2.5 per cent of the improved farm land in these States, oats about reaching that figure in Virginia and West Virginia. Rye does not occupy 1 per cent of the improved acreage in any of the four States. It is of greatest importance in Maryland (0.8 per cent) and Virginia (0.7 per cent). These figures represent the acreage harvested for grain. The acreage of rye sown is no doubt considerably greater, as many acres are plowed under for green manure each year.

GENERAL PHYSICAL CONDITIONS

The three great natural divisions of the South Atlantic States are the Appalachian Mountains on the west, the Atlantic Coastal Plain on the east, and the Piedmont Plateau between. The elevation in these States varies from sea level to more than 3,000 feet. Climatic and soil conditions in the three sections are also markedly different. As a result, varieties and methods of culture of the different grain crops well adapted to one section are not always the best for another.

Rainfall in this section of the United States is usually ample for crop needs without special methods of moisture conservation such as are commonly practiced in regions of limited rainfall. Destructive winds and hailstorms very rarely occur, and comparatively mild winters usually prevail. In the vicinity of Washington, D. C., the lowest winter temperature usually ranges from zero to 10° F., falling as low as zero only about once in three years. In the higher western portions of Maryland and Virginia and in West Virginia the winters are much colder, zero temperatures occurring nearly every year. Only the hardier fall-sown grains, winter wheat and rye, survive there with certainty, though winter oats and winter barley can be grown successfully in favorable locations if sown early.

SOILS

Many different types of soil are to be found in the South Atlantic States, varying from the lightest sands to the heaviest clays.

Loam soils are the most suitable for the production of grain; hence the clay loams of the Piedmont section and the sandy loams of the Coastal Plain are well adapted to this purpose. The heavier clay and silt loams in the valleys west of the Blue Ridge, especially those of limestone origin, are among the best wheat soils in the United States. The best example of this type is the Hagerstown loam, a silt loam overlying a clay subsoil.

The typical soils of the Coastal Plain area are lighter and more sandy, including such well-known types as the Leonardtown loam and the Sassafras sandy loam. These soils when well supplied with lime and vegetable matter in connection with proper fertilization and a good system of crop rotation will produce profitable crops of

winter wheat and other fall-sown grains. Winter oats are well adapted to these more sandy soil types and should be more generally grown than they are at present.

Fall-sown grains require a well-drained soil. In those sections in which the land is not naturally well drained, tile or other drainage should be supplied, as thorough surface and subsoil drainage is one of the first essentials for the production of profitable yields. Poor soil drainage is more often the cause of winterkilling and consequent failure of winter grain crops than any other soil condition.

FERTILIZERS

Practically all the soils of the eastern United States which have been tilled for many years are deficient in the more important elements of plant food. Phosphorus, nitrogen, and in some localities potassium (potash) must be supplied in order to obtain satisfactory yields of grains and other field crops. These are in addition to liberal supplies of lime and humus, or decayed organic matter.

In those sections where the soil is in a good state of fertility, because a good system of crop rotation has been followed or because livestock has been included in the scheme of farming, phosphorus is usually the element that is most needed. It may be supplied by the addition of some form of phosphatic fertilizer, such as acid phosphate, ground rock phosphate (floats), steamed bone meal, or basic slag.

Of all the so-called carriers of phosphorus, acid phosphate has proved to be the most effective in proportion to cost under most soil conditions. In relative value and effectiveness, basic slag and steamed bone meal rank next. Rock phosphate does not always return a profit on its cost; in fact, the effectiveness of acid phosphate usually is so much greater as to render the use of rock phosphate relatively unprofitable. When available at moderate cost, rock phosphate should be used only in combination with stable manure or green manure.

The principal sources of nitrogen are manure, the nitrate fertilizers, and the air. Of the nitrate fertilizers the most common are nitrate of soda, ammonium sulphate, cottonseed meal, tankage, and dried blood. The greatest and cheapest source of nitrogen is the air, for by growing such leguminous crops as clovers, cowpeas, soy beans, and vetch in rotation or as catch crops, nitrogen from the air is added to the soil much more economically than by the use of mineral fertilizers.

Soil analysis shows that most soils contain sufficient quantities of potassium (potash), but often it is not in a form available to plants. This condition usually can be corrected by the generous use of barnyard manure or green manure. The decay of this material in the soil ordinarily makes sufficient quantities of potash available for crop needs. Where barnyard manure is not produced in sufficient quantities, or the plowing under of green manure is not practicable, potassium must be supplied in the form of commercial fertilizers. Those most commonly used are sulphate of potash, muriate of potash, and kainit.

Calcium or lime is supplied in either the burnt (calcium oxide), the slaked (calcium hydroxide, or hydrated lime), or the raw form

(calcium carbonate), to improve the physical and chemical condition of the soil. Its chief function is to correct soil acidity, to "sweeten the soil," making it more suitable for the various soil organisms which aid plant growth. Only a small percentage of lime is actually taken up by cereal plants. Humus, or decayed organic matter, is supplied in barnyard manure or green manure and in crop residues (stubble, second growth, weeds, etc.).

The best results with small grains are usually obtained if the barnyard manure is applied to a preceding cultivated crop, such as corn or potatoes. When applied to the grain crop directly, the excess of nitrogen in the manure is likely to produce a heavy growth of straw, which may lodge. If the manure is applied to the small-grain crop it should be supplemented by 200 to 250 pounds of acid phosphate or rock phosphate (floats). This is also good practice when a heavy growth of cowpeas or other green crop is plowed under immediately preceding the grain crop.

A complete fertilizer usually gives the best results on thin soils, especially where little or no barnyard manure or green manure is available. If wheat follows oats or some other small-grain crop on land of fair to medium fertility, it will usually pay to use some nitrogen and potassium in the fertilizer. A 3–10–3 fertilizer—that is, one which contains 3 pounds of nitrogen for each 10 pounds of phosphorus and 3 of potassium—gives a very good proportion if a sufficient quantity is applied. On the worn soils of southern Maryland and east of the Blue Ridge in Virginia from 350 to 450 pounds of this fertilizer to the acre should give fair results. On the more fertile soils, especially those lying immediately to the west of the Blue Ridge in Maryland and Virginia, 150 to 250 pounds to the acre are sufficient.

If additional nitrogen is used, it should be applied as a top-dressing at about the time growth starts in the spring. For the spring application 75 to 125 pounds of nitrate of soda to the acre are most commonly used. Experiments conducted by several of the experiment stations in the eastern United States indicate that top-dressing the small grains is usually profitable only when the crop is in a backward condition as the result of poor land, late seeding, abnormal weather conditions, etc. If the crop is well supplied with plant food, the use of nitrate of soda in this manner is of doubtful value. No nitrogen is needed if leguminous green-manure crops, such as crimson clover or vetch, are grown in the rotation.

Half a ton to a ton of burnt lime or from 1 to 2 tons of ground or crushed limestone to the acre is a sufficient quantity to apply to most soils needing lime in the section under discussion. Heavier applications may be made, but it is usually considered better practice to make frequent light applications. There is then less loss through seepage and leaching. Two tons of ground limestone every four years is usually a satisfactory rate.

ROTATIONS

In those sections of the South Atlantic States in which general farming is practiced one or more of the fall-sown grain crops usually occupy an important place in the rotation. In addition to their value as grain crops they serve as nurse crops for clover and grass, as winter cover crops, and frequently as winter pasture crops.

The continuous cropping of land to wheat or any other small-grain crop results in reduced yields and a depleted soil. A rotation of grain crops is not advisable, as it is little better than continuous cropping. By using large quantities of chemical (commercial) fertilizers it is possible to grow grain crops continuously on the same land for a long period of years, but the cost of the fertilizers makes such a practice unprofitable.

A good rotation should include a cultivated crop as well as a legume. The frequent stirring of the soil renders it loose and friable, improving its physical and chemical condition and making it more congenial to plant growth. In addition to this beneficial effect, the cultivation of row crops tends to destroy weeds and aids in keeping the land free from these pests.

The legumes not only gather nitrogen from the atmosphere and store it in the soil in a form available to succeeding crops, but also aid in maintaining the supply of humus. The clovers, cowpeas, and soy beans are the principal legume crops included in rotations with winter grains.

As a rule, local conditions determine the particular crops to be grown and their order in the rotation. For the greater portion of the Piedmont area and for many of the broad valleys west of the Blue Ridge a four-year rotation of corn, wheat, and two years of clover and timothy or a five-year rotation of corn, wheat two years, and clover and timothy two years, is the most practicable. By growing wheat twice in succession, as indicated in the second of these rotations, better conditions can be obtained for sowing to grass and clover. Meadows which result from "sowing down" with wheat on disked corn-stubble land are often rough and uneven, making the use of modern haying machinery more or less difficult. The timothy should be sown with the wheat in the fall and the clover sown early in the following spring. In some districts of the lower Piedmont section fall-sown oats or barley may be added to the rotation with profit.

For Delaware, eastern and southern Maryland, and practically all of the upper Coastal Plain section of Virginia, similar rotations are adapted. Here crimson clover, cowpeas, and soy beans grow well, and one or more of these crops should be included in the rotation either for hay or for green manure. A five-year rotation of corn, corn, wheat, winter oats, and clover is practicable. In this rotation crimson clover should be sown in the first crop of corn at the last cultivation and plowed under the following spring for the second crop of corn. It is also possible to grow a crop of cowpeas or soy beans for hay or green manure between the two small-grain crops.

A rotation that should be well adapted to these sections is as follows: (1) Corn, followed by rye, vetch, crimson clover, or rye and vetch, to be cut for hay or plowed under the following spring for green manure; (2) cowpeas or soy beans for hay; (3) wheat or fall-sown oats; (4) clover. This rotation provides for a cover crop each year, a crop that may be removed from the land each year, one green-manure crop, and two legumes. By supplementing these soil-improvement crops with generous applications of raw or rock phosphate in connection with the proper use of lime and the manure that

is available on the average farm, such a rotation system should prove practicable, while at the same time it will maintain and gradually increase the fertility of the soil. This rotation is suitable also for some of the lower districts of the Piedmont area, particularly those in which straight grain farming has been generally practiced.

Other rotations, including one or more of such crops as potatoes, tobacco, rye, alfalfa, etc., in addition to any of the crops already mentioned, may be devised along similar lines.

PREPARATION OF THE SEED BED

The ideal seed bed for fall-sown grains is one in which the surface soil to a depth of 2 or 3 inches is loose and finely pulverized, while the subsoil is firm and moist. To obtain these conditions the land should be plowed to a depth of 6 to 8 inches as early in the season as possible. For the best results the harrow should follow the plow immediately. Harrowing should be repeated frequently to kill weeds, to aerate the soil, and to settle the seed bed, especially the lower portion of the furrow slice. Late plowing does not allow the soil to become sufficiently compact for the best results.

In those sections in which the winter grain crop follows corn, the best seed bed usually can be prepared by disking and harrowing rather than by plowing. If weeds are numerous, plowing may be desirable. As plowing must be delayed, however, till the corn is mature, there is usually not sufficient time for the seed bed to become well settled before sowing. For this reason the land should not be plowed unless the weeds are so large and numerous that the disk harrow can not be used effectively.

When a heavy growth of cowpeas or other green-manure crop is plowed under, preceding winter grains, the plowing should be done at least two or three weeks before seeding time, in order to allow the vegetable matter plowed under to begin to decay and to become mixed with the soil. When these crops have been removed for hay a good seed bed usually can be prepared by disking and harrowing.

A well-prepared seed bed always greatly increases the chances of success in growing fall-sown grains. The importance of a good seed bed can not be too strongly emphasized. Thorough tillage in its preparation helps in offsetting the effects of drought and other unfavorable conditions.

THE SEED

Experiments show that home-grown seed gives better returns than that brought from a distance. Changing seed is not to be encouraged if the variety grown is pure and is adapted to the locality.

All seed grain should be fanned and graded to remove weed seeds, chaff, straw, smut balls, and small or broken grains. This can be done with an ordinary fanning mill if it is properly adjusted.

Bunt or stinking smut of wheat, smut of oats, and covered smut of barley can be controlled by the formaldehyde treatment. Commercial formaldehyde (about 37 to 40 per cent pure formaldehyde) may be obtained at almost any drug store. To apply this treatment, mix the formaldehyde with water at the rate of 1 pound (slightly less than a pint) to 40 gallons of water. Spread the grain on a clean

floor or canvas and sprinkle with the solution, shoveling the grain over during the process so that the surface of every grain is thoroughly wet. About a gallon of the solution will be needed for each bushel of dry grain. Immediately after sprinkling, shovel the grain into a pile, cover it with sacks wet with the solution, and allow it to stand for at least two hours before spreading it out to dry.

Instead of sprinkling the grain, it may be inclosed loosely in bags and immersed in a tub of the solution, or the loose grain may be put directly into it. The grain should be left in the solution only long enough to make sure that all of it has been wet. When loose grain is put into the solution the effectiveness of the treatment is increased by skimming off the smut balls that come to the surface.

The treated grain may be sown as soon as it is sufficiently dry to run through the drill. If the seed is still moist, however, the drill must be set to sow a greater quantity to the acre than if it is dry. The treated seed should not be allowed to come in contact with bags, bins, or machinery in which there may be smut spores. To avoid this danger, drills, bags, etc., should be washed with the formaldehyde solution before putting the treated grain into them.

A more satisfactory seed treatment, recently discovered, for the control of bunt (stinking smut) of wheat is to dust the seed with dry copper carbonate. This treatment is not satisfactory, however, for the control of the smuts of oats and the covered smut of barley. Use 2 ounces (2 heaping tablespoonfuls) of copper carbonate, manufactured for seed-treating purposes, for each bushel of wheat to be treated. To be effective, copper carbonate dust should be thoroughly spread over the surface of each wheat kernel. This can be done by mixing thoroughly in some type of rotary machine. A homemade barrel mixer, an old rotary churn, or a concrete mixer may be used. Satisfactory machines can be bought on the market. Copper carbonate should not be mixed with grain by shoveling on the floor, as the dust causes irritation and even nausea or sickness if inhaled. Use a mask or wet cloth over the nose and mouth while treating the seed. Treated seed may be stored without injury or sown immediately after treating. Treated seed often germinates better than untreated seed. Do not attempt to use or market treated seed for food or feeding purposes. Copper is poisonous. Bread made from wheat treated with copper carbonate is not fit to eat even if the treated wheat is thoroughly scoured before milling. For further information regarding the copper-carbonate seed treatment, see Department of Agriculture Circular 394.[1]

For the loose smut of wheat and barley the hot-water treatment is the only effective preventive yet known. This treatment must be used with great care or the germination of the seed will be destroyed. For particulars regarding it and also for fuller details of the formaldehyde treatment, see Farmers' Bulletin 939.[2]

The germination of wheat, oats, and barley is usually good. Rye quickly loses its germinating power, and seed of this grain more than a year old should not be used unless a test shows that it will

[1] TISDALE, W. H. COPPER CARBONATE PREVENTS BUNT (STINKING SMUT) OF WHEAT. U. S. Dept. Agr. Circ. 394, 10 pp., illus. 1926.

[2] HUMPHREY, H. B., and POTTER, A. A. CEREAL SMUTS AND THE DISINFECTION OF SEED GRAIN. U. S. Dept. Agr., Farmers' Bul. 939, 28 pp., illus. 1918.

germinate. Germination tests may be made at home, or samples may be sent for this purpose to the seed laboratory of the appropriate State experiment station or of the United States Department of Agriculture.

SOWING THE SEED

TIME OF SOWING

Winter grains should be sown early enough to allow the plants to become well started before continued freezing weather begins. However, they should not be sown so early as to allow them to start jointing in the fall. In those sections in which the Hessian fly is troublesome, the sowing of wheat should be delayed until about the time the Hessian fly ceases to lay eggs. If the young wheat plants come up before that time, eggs are deposited on them and later the crop is injured by the insects which develop from these eggs. In Frederick County, Md. (altitude about 600 to 1,000 feet), wheat sown after October 1 usually escapes injury from this pest. Farther south later seeding is necessary. Seeding should be delayed one day from October 1 for each 12 to 15 miles of distance south of Frederick County. There should also be a delay of one day for each decrease of 100 feet in altitude. Thus, in the Coastal Plain section of Delaware, where the altitude is 500 to 800 feet lower, seeding should be about one week later than in Frederick County, or about October 8. In the Coastal Plain section of southern Virginia, which is 125 to 175 miles farther south, there should be an additional delay of 10 to 15 days, making October 20 the safe date for seeding to escape Hessian-fly injury. The dates above mentioned are subject to considerable variation as a result of weather conditions. Excessive dampness tends to hasten the emergence period of the fly, whereas drought delays it. In no case should seeding be delayed so long that the plants do not make sufficient growth to withstand the winter. If sown on well-prepared soil at the dates here recommended, there will be little danger of loss from winter injury. For further information on how to prevent losses from the Hessian fly see Farmers' Bulletin 1083.[3]

Winter rye may be sown with safety from one to two weeks later than wheat. However, earlier seeding of rye than is ordinarily practiced is recommended. In a varietal test of winter rye at the Arlington Experiment Farm of the Department of Agriculture near Washington, D. C., excellent results have been obtained for several years by sowing this crop at the same time as wheat.

Winter oats should be sown a week to 10 days earlier than wheat. For eastern and southern Maryland and eastern Virginia the best time for sowing is during the last two weeks of September and the first week of October. In West Virginia and in western and northern Maryland winter oats should be sown not later than September 10. In the mountain section of Virginia oats may be sown from September 1 to 20. Winter barley should be sown at about the same time as winter oats. In the Piedmont and mountain sections winter barley should be sown about a week earlier than wheat.

[3] WALTON, W. R. THE HESSIAN FLY AND HOW TO PREVENT LOSSES FROM IT. U. S. Dept. Agr., Farmers' Bul. 1083, 16 pp., illus. 1920.

METHOD OF SOWING

In experiments in which drilling and broadcasting winter grains have been compared, better yields have usually been obtained from drilling. A more economical and uniform distribution of the seed, a higher percentage of germination, and a more even stand are among the chief advantages of drilling.

On a well-prepared seed bed containing plenty of moisture, from 1 to 1½ inches is a sufficient depth to sow winter grains. In dry seasons the depth should be increased to 2 or 3 inches, because the seed must reach moist soil to insure quick germination.

The drills commonly used in this section are equipped with various furrow-opening devices, which place the grain in rows 7 or 8 inches apart. The hoe, shoe, and disk drills all do good work on a well-prepared seed bed free from trash. For sowing on disked corn-stubble land or where there is other trash, the disk drill, preferably the single-disk type, is superior. The hoe and single-disk drills place the grain in a much more distinct furrow than either the shoe or double-disk drill. This is an advantage, as the ridges protect the plants from cold winds and also collect and hold snow. For this reason also drag chains, press wheels, and other leveling devices are not ordinarily used in drilling winter grains in this section.

RATE OF SEEDING

On medium to fertile soils winter wheat should be sown at the rate of 6 pecks per acre. On highly productive soils 4 to 5 pecks are sufficient in a well-prepared seed bed. In rate-of-seeding experiments conducted on the Arlington Experiment Farm the best yields of wheat have been obtained from seeding at rates varying from 4 pecks to 6 and 7 pecks per acre.

Winter rye should be sown at the rate of 6 pecks per acre. On very productive soils 4 to 5 pecks is a sufficient quantity of seed to sow.

Winter spelt should be sown at the rate of 3 to 4 bushels (90 to 120 pounds) per acre. As the kernels do not thresh free from the glumes (chaff or hulls), the grain is rather bulky. For this reason it is necessary to sow a large quantity of seed per acre.

Winter oats should be sown at the rate of 6 to 8 pecks per acre for all varieties other than those of the Red Rustproof group. These oats have large kernels with tufts of hairs at the base and with beards which do not break off in threshing. Because of these characteristics the kernels do not pack together like those of other varieties, and they do not feed freely through the drill. For this reason 10 to 12 pecks of Red Rustproof oats should be sown to the acre.

Winter barley should be sown at the rate of 8 to 10 pecks per acre, preferably the former.

While these rates for the several classes of small grains are generally applicable in the section here discussed, allowances should always be made for poor germination, inferior quality of seed, a poorly prepared seed bed, lateness of seeding, and unproductive soil, and the rate of seeding should be increased accordingly.

HARVESTING

WHEN TO CUT

The small grains should be cut at the time when the largest yield of the best quality can be obtained. Wheat and other grains are ready to cut when only a slight tinge of greenness remains in the straw. The hardness of the kernel is also an indication of maturity, the grain being ready to cut when it is passing out of the hard-dough stage.

As the acreage of grain on most farms in this section is comparatively small, wheat and rye usually may be allowed to stand until fully ripe. If wheat is allowed to become overripe the bundles made by the self-binder are hard to shock. The loss by shattering in allowing oats and barley to stand after they have passed the hard-dough stage will be greater than the increase in yield of the crop through increase in weight.

SHOCKING

Small grain should be shocked carefully in this section. The importance of good work in setting up a shock of grain is often not fully realized. When the work is not well done a great number of shocks often go down or the caps blow off, causing damage to the grain and loss of the time necessary for resetting or recapping the shocks.

The chief objects in shocking grain are to allow it to cure properly and to protect it from sunshine as well as from dampness. The protection from sunshine is of more importance than is sometimes realized. The effect of sunshine is to bleach the grain and injure its quality.

The following method of shocking is convenient and satisfactory. The shock built by this method protects the grain and also stands up well. First, set up two bundles, flat sides together. Most binders make bundles which are not round but somewhat flattened. These bundles should be set down with the butts slightly apart, squarely and firmly, so that they will stand alone under ordinary conditions. Next set another bundle at each end of this pair, so that there will be four in a row. Then set one in the middle of each side. This will leave a space at each of the four corners, in which a bundle should be placed. There are now 10 bundles in the shock, which is about the proper number ordinarily. If the grain is very dry or overripe a few more bundles may be set around the shock where they seem to fit best. In making this kind of shock in windy weather it is better to set the third and fourth bundles at the sides instead of at the ends as just described. The end bundles may then be added and the shock completed as before. The result is the same in either case, but the latter method is easier when the wind is strong enough to interfere with the work.

When the required number of bundles is set up, the shock should be capped. There is some difference of opinion as to whether one or two bundles should be used for capping. One cap allows more circulation of air through the shock, so that the grain dries out more quickly if the shock becomes wet. Less labor is required also, as only one bundle has to be broken. The chief advantage in using two

caps is the greater protection afforded, as the grain does not get wet so readily.

A bundle to be used for a cap is broken by supporting it with the butts on the knees and with one forearm and hand under it at the band, while the straw is broken over just above the band with the other hand. If one cap is used, the grain end always should be placed in the direction of the prevailing winds. If two are used, the second cap should be placed similarly and at right angles to the first. By devoting some attention to this detail very few caps will be blown off under ordinary weather conditions.

STACKING

In Delaware, Maryland, and the Virginias, grain is often stored in barns from the time it is cured in the shock till it is threshed. This is the most satisfactory method of handling the crop from a small acreage. If, however, there is not sufficient storage space, it should be stacked. In stacking, unless an unusually dry location is available, it is best to build a temporary base of fence rails or other light timbers to keep the stack from coming in contact with the ground and absorbing moisture from it. Usually two layers of timbers, the second placed at right angles to the first, will make a satisfactory foundation. The size of the foundation, of course, varies with the size of the stack which is to be built.

To build a round stack, begin at the center with two bundles, precisely as in building a shock; then add bundles to the sides of the shock, placing each one a little flatter, until a basal diameter of 10 to 12 feet has been reached. Lay all bundles with the butts outward. The stacker progresses to the left, or counter clockwise, and the pitcher places the bundles at the stacker's left, butts to the front.

Start the second layer by placing a row of bundles at the outer edge. The second row should be laid between the bundles of the outer row with the butts extending just past the bands of the outer bundles, and so on to the center, overlapping the rows a little more as the center of the stack is approached, when the builder will start again at the outside and proceed with the third layer.

As shocked bundles have a slanting butt, lay the successive outer rows with the long side of the bundle up and extending slightly beyond the layer beneath. The diameter is gradually increased in this way until a height of 7 or 8 feet is reached. This forms the bulge. To reduce danger of slipping while building the bulge, the so-called double-row or triple-row courses of bundles may be laid. Instead of laying a single row at a time a course containing two or three rows is laid at each successive round.

Always keep the center high, well tramped, and free from holes. The outer row, however, should not be tramped, so that when the stack settles the straws in the exposed butts will slope distinctly downward and thus shed water perfectly.

From the bulge the stack should taper gradually to a point. The bundles are laid with the short side of the sloping butts up, which decreases the diameter with each successive layer and gives about the desired slope and smoothness to the stack. One row of bundles is usually laid at a time in building the top of the stack, as the drawing-in process greatly lessens the danger of slipping. It is very impor-

tant in topping the stack that the center be kept well filled and solid, keeping it distinctly higher than the outside and thus forming a good slope downward to the rim of the stack. This is best done by overlapping the rows a little more as the center is reached. The middle also may be kept full by laying some of the inside bundles with the heads out.

The top bundles of the stack should be put on like those of a cap for a shock. These may be held in place by driving a sharpened stake 6 to 8 feet long down into the center. Weights made of two light timbers tied together with rope or wire also may be hung across the top of the stack to keep the top bundles in place.

Long stacks or ricks may be built similarly. However, more skill is required to build this type of stack, for which reason the smaller round stack usually is preferable.

THRESHING

The threshing of any small-grain crop should never be attempted when it is damp or when it is passing through the sweat. It will not only be difficult to thresh—the straw wrapping around the cylinder and the shafts of the separator—but all the grain may not be removed from the straw. If grain is threshed when damp, there is danger that it will heat and spoil in the bin. If the farmer wishes to keep his variety as pure as possible, it is advisable to keep the first 25 to 50 bushels threshed separate from the remainder of his crop, for by so doing the danger of mixing the variety grown on his neighbor's farm with that on his own is reduced to a minimum. When the bulk of the crop is not to be utilized for seed, enough grain for sowing on one's own farm and for sale to any neighbors who may want to buy or exchange seed may be set aside when the crop is about half threshed.

VARIETIES TO GROW

The best measure of the value of any variety of wheat or other small grain is its yield in bushels per acre in comparison with other and similar varieties. No other quality is so important as the ability of a variety to produce a high-average yield. Varietal experiments with the various fall-sown grains have been conducted by the Office of Cereal Crops and Diseases of the United States Department of Agriculture at the Arlington Experiment Farm, near Washington, D. C., and prior to 1915, in cooperation with the Maryland Agricultural Experiment Station at College Park, Md.[4] Results obtained from the varietal experiments at Arlington Experiment Farm since 1915 have been reported recently by Taylor.[5] The methods used in growing the varieties in these experiments were as similar as possible to those used in good farm practice in the sections of Maryland and Virginia to which the results are believed to be applicable. Every effort was made to procure uniform conditions, so as not to give one variety or group of varieties any undue advantages over others. These experiments have been conducted for 5 to 15 years.

[4] For full details of these experiments, see STANTON, T. R. CEREAL EXPERIMENTS IN MARYLAND AND VIRGINIA. U. S. Dept. Agr. Bul. 336, 51 pp., illus. 1916.

[5] TAYLOR, J. W. EXPERIMENTS WITH SMALL GRAINS ON THE ARLINGTON EXPERIMENT FARM. U. S. Dept. Agr. Bul. 1309, 28 pp., illus. 1925.

Varietal experiments with winter grains also have been conducted by the State agricultural experiment stations at Newark, Del., Blacksburg, Va., Morgantown, W. Va., and College Park, Md., since 1915. Only the stations of Maryland and West Virginia have issued bulletins recently on the results of their experiments with these crops, but the recommendations here made are based on recent correspondence with the agronomists who are conducting the experiments.[6]

WINTER WHEAT

In the cooperative varietal experiments at College Park, Md., conducted during the eight years from 1907 to 1914, inclusive, the leading red wheats were China and Currell, beardless varieties with glabrous (nonhairy) brown chaff, and Mammoth Red, Bearded Purplestraw, Turkish Amber, Fulcaster, and Dietz, all bearded wheats with glabrous white chaff. Data presented in a bulletin of the University of Maryland Agricultural Experiment Station[7] indicate that these varieties have not been displaced since. Currell, a variety which has been grown almost continuously since the establishment of the station, has a 30-year average yield of 28.7 bushels per acre as compared with a 29-year average of 26.3 for Fultz and a 13-year average of 28.2 for China. Dietz has a 15-year average yield of 27.9 bushels as compared with a 13-year average of 27.7 for both Mammoth Red and Turkish Amber and 27.1 for Bearded Purplestraw. A 12-year average yield of 24.8 bushels is shown for Fulcaster.

The leading varieties of red wheat at the Arlington Experiment Farm prior to 1915 were Purplestraw and Fultz, beardless with glabrous white chaff; Poole, beardless with glabrous brown chaff; and Fulcaster, bearded with glabrous white chaff. Recent data obtained from the experiments at Arlington show that these varieties still rank among the high yielders, with the addition of Leap (Leap Prolific) and Potomac, beardless sorts with glabrous white and brown chaff, respectively; and Mammoth Red, a bearded wheat, with glabrous white chaff, similar to Fulcaster. At Arlington the bearded varieties have not produced quite as high average yields as the best beardless varieties. Heads of several of these varieties are shown in Figure 1.

For Delaware, the bearded varieties recommended are Pennsylvania No. 44, Farmers Friend, and Stoner (Miracle). The best beardless varieties are Leap, Poole, and Currell. In general, the bearded varieties have given better results than the beardless ones. At the Virginia Agricultural Experiment Station, V. P. I. No. 131, Fulcaster, Stoner (Miracle), and Mediterranean are the leading bearded varieties, with V. P. I. No. 112, Leap, and Fultz among the best beardless ones. At the West Virginia station, Poole, Fulhio, Currell, Fulcaster, and Fultz are recommended.[8]

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[6] The data on varietal experiments at their respective stations have been supplied by G. L. Schuster, T. B. Hutcheson, and R. J. Garber, agronomists of the Delaware, Virginia, and West Virginia Agricultural Experiment Stations, respectively.

[7] METZGER, J. E., and EPPLEY, GEARY. VARIETY TESTS OF CORN, WHEAT, AND SOY BEANS. Univ. of Md. Agr. Exp. Sta. Bul. No. 237, 23 pp., illus. 1920.

[8] GARBER, R. J., QUISENBERRY, K. S., ODLAND, T. E., and MCILVAINE, T. C. VARIETAL EXPERIMENTS WITH WHEAT, OATS, BARLEY, RYE, AND BUCKWHEAT. (A preliminary report.) W. Va. Agr. Exp. Sta. Bul. 192, 26 pp., illus. 1924.

These experiments show that numerous varieties do well in the section under discussion. Many of these, however, are very similar, and often several names are used for what is really only one variety. Among the varieties which can be most strongly recommended are the following:

For the Coastal Plain.—Bearded varieties: Fulcaster, Pennsylvania No. 44, and Stoner (Miracle). Beardless varieties: Currell (Currell Prolific), Fultz, Leap (Leap Prolific), Poole, and Potomac.

For the Piedmont area.—Bearded varieties: Dietz, Fulcaster, Mammoth Red, and V. P. I. No. 131. Beardless varieties: China, Currell (Currell Prolific), Fultz, Leap, Poole, Purplestraw, Potomac, and V. P. I. No. 112.

For the mountain section.—Bearded varieties: Fulcaster. Beardless varieties: China, Currell (Currell Prolific), Fulhio, Fultz, Harvest King, Leap, and Poole.

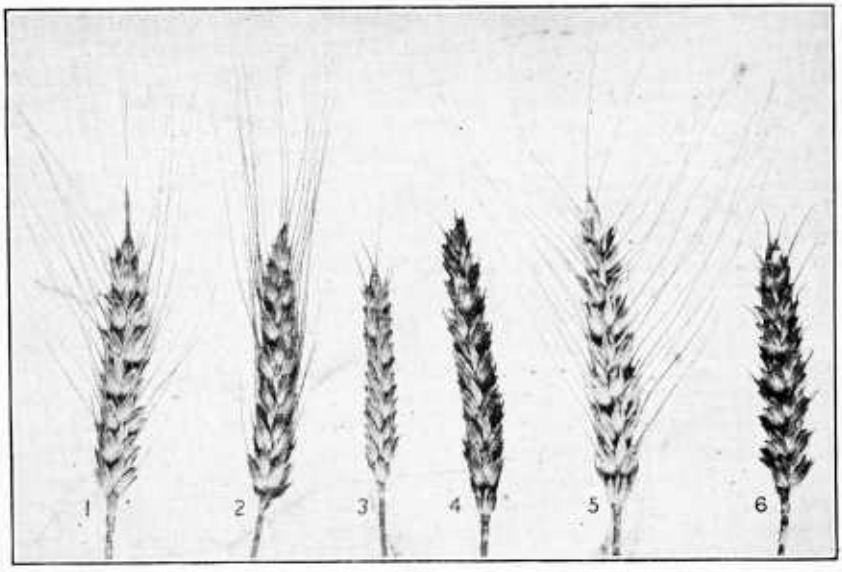

FIG. 1.—Heads of six varieties of winter wheat grown at the Maryland Agricultural Experiment Station and at Arlington Experiment Farm: 1, Dietz (Dietz Longberry); 2, Missouri Bluestem; 3, Purplestraw; 4, China; 5, Bearded Winter Fife; 6, Dawson Golden Chaff

All of the varieties mentioned are red wheats. Dawson (Dawson Golden Chaff), a white-kerneled variety, produces high yields, but is not as good for flour as the red wheats, for which reason it has become a relatively unimportant variety in these sections.

WINTER SPELT AND EMMER

Varieties of spelt and emmer were included in the cooperative experiments at College Park, Md., during the eight years from 1907 to 1914, inclusive. These grains have been included in varietal experiments at the Arlington Experiment Farm since 1910. Spelt and emmer are closely related to wheat, but they do not thresh free from the chaff. They are used as feed for domestic animals and are similar to oats in feeding value.

At College Park the Alstroum and Red Awnless varieties of spelt produced 6-year average yields of 73 and 70 bushels of 30 pounds

each, respectively, whereas at Arlington they have made 11-year averages of 71.6 and 69.2 bushels, respectively. Both are beardless varieties. The Alstroum has white glumes (chaff) and the Red Awnless has red glumes. Black Winter emmer has produced very low yields as compared with spelt. At both College Park and Arlington the average yield has been less than one-half that of spelt, and therefore it is decidedly less promising. The Alstroum and Red Awnless spelts are recommended for growing for feed in place of oats and barley, as in pounds of actual feed per acre they yield more than either of these crops. Heads of spelt and emmer are shown in Figure 2.

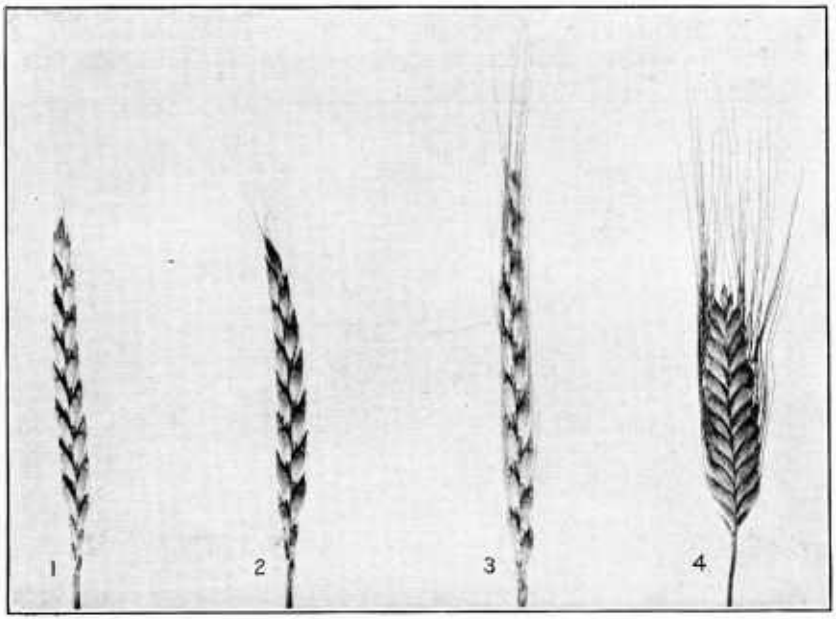

FIG. 2.—Heads of three varieties of spelt and one variety of emmer grown at the Maryland Agricultural Experiment Station and at Arlington Experiment Farm: 1, Alstroum spelt; 2, Red Awnless spelt; 3, Servia spelt; 4, Black Winter emmer

WINTER RYE

Nearly all the varieties of winter rye which have been included in the varietal experiments at the Arlington Experiment Farm have yielded well. According to recent data obtained at that place, Abruzzes and Von Rümker No. 2 lead in average yield and desirability and therefore are to be recommended. These are tall, vigorous-growing, large-strawed varieties, producing large brownish kernels. Heads of varieties of rye are shown in Figure 3.

Rosen rye has been given a trial, but this variety apparently is too late for best results in the South Atlantic section. The varieties of rye which have proved most satisfactory at the Virginia station are Abruzzes and Giant Winter. No varieties are especially recommended for Delaware and West Virginia. It is sometimes difficult

to obtain named varieties of rye on the market in this section, "winter" rye being commonly sold. This usually is the rye commonly known as Virginia Winter. The differences in yield and appearance among most of the more common varieties of rye are not great, and in this section any good winter rye should give satisfactory results.

WINTER OATS

Varieties of winter oats were included in the cooperative varietal experiments at College Park, Md., during the eight-year period from 1907 to 1914, inclusive. The plot experiments at the Arlington Experiment Farm have been in progress for 15 years. At College Park the leading variety in yield has been Winter Turf (Virginia Gray), a late-maturing gray oat. Culberson, a medium-early yellowish white variety, also has yielded well. At the Arlington farm,

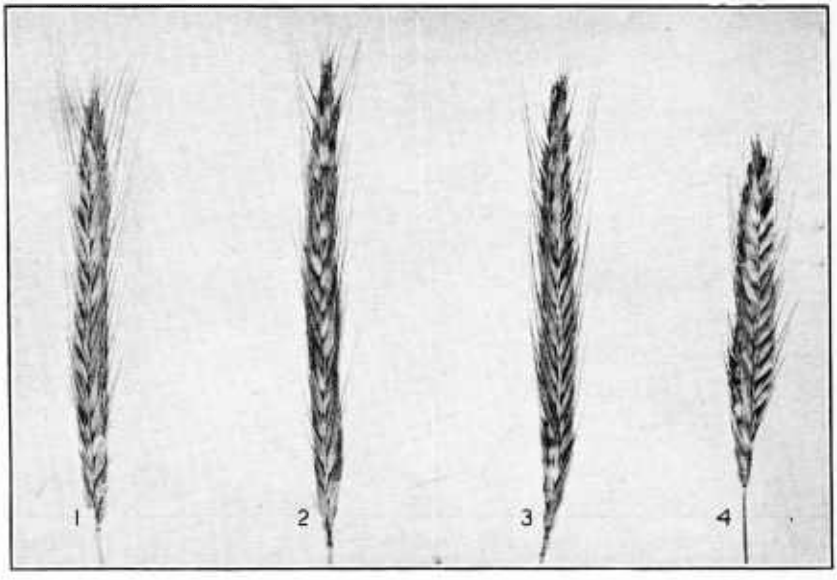

FIG. 3.—Heads of four varieties of winter rye grown at Arlington Experiment Farm; 1, Giant Winter; 2, Virginia Winter; 3, Abruzzes; 4, Henry

Winter Turf has been the leading variety in average acre yield. Two strains of this oat have been developed here which have outyielded the best commercial strains by about 8 bushels in the 10-year period from 1916 to 1925, inclusive. The 10-year average for the best commercial strain is 55.7 bushels, compared with 63.9 and 63.3 bushels, respectively, for the two improved strains. Lee, a selection from a Winter Turf–Aurora cross, has been very promising. It has made an average yield at Arlington of 69.6 bushels, as compared with 65.6 for the best Winter Turf selection in the four-year period from 1922 to 1925, inclusive. In addition, Lee produces grain of excellent quality.

Of the older varieties, Culberson easily ranks second in average yield at the Arlington Experiment Farm, as both Red Rustproof and Fulghum have fallen considerably below it and Winter Turf in

average yield. Owing to reduced stands as the direct result of winterkilling during severe winters, these varieties have not been able to compete with the hardier Winter Turf and Culberson varieties, which outyield them about 15 bushels per acre on the average at Arlington. At the Virginia Agricultural Experiment Station Tech (V. P. I. No. 1), Winter Turf, and Culberson are best.

As both the Winter Turf and Culberson are hardier than the Red Rustproof and Fulghum, they are especially recommended, particularly Winter Turf, for the Piedmont and mountain sections and for Delaware. In the Coastal Plain sections of Maryland and Virginia, Culberson and Fulghum are to be preferred because of their earlier maturity. Heads of two of these varieties are shown in Figure 4.

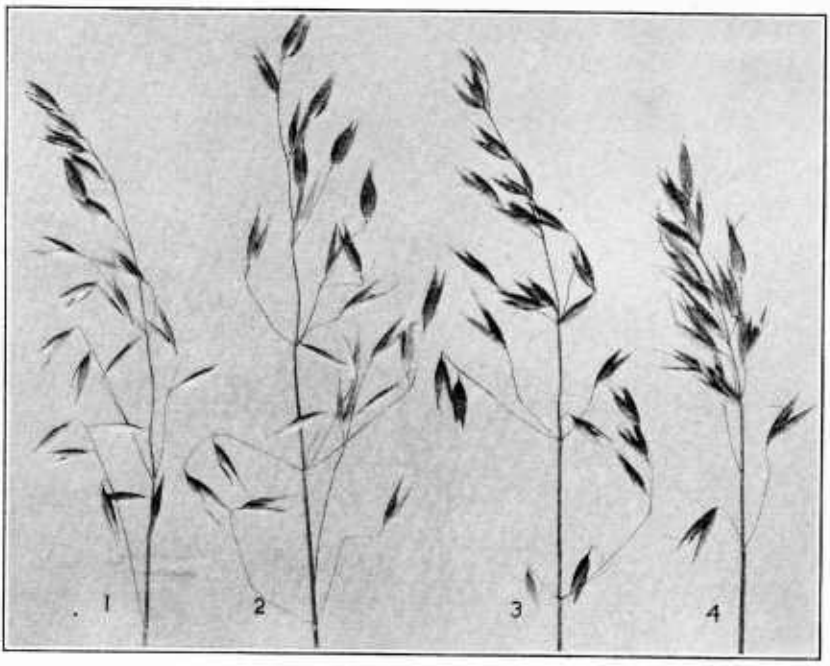

FIG. 4.—Heads of four varieties of winter oats grown at the Maryland Agricultural Experiment Station and at Arlington Experiment Farm: 1, Culberson; 2, Bicknell; 3, Winter Turf; 4, Red Rustproof

WINTER BARLEY

Results from varietal experiments with winter barley carried during 8 and 15 years are available from College Park and Arlington, respectively. The leading variety in yield at each place has been Tennessee Winter and Wisconsin Winter, respectively, both bearded 6-rowed forms. According to recent data other promising varieties have been Han River and Pidor, bearded 6-rowed barleys.

Varieties known as Maryland Winter and Union Winter are practically identical with Tennessee Winter. Of the varieties of winter barley that have been tried by the Virginia Agricultural Experiment Station, Tennessee Winter and Union Winter seem best adapted. Heads of winter barley are shown in Figure 5.

Winter barley is hardier than winter oats and can be grown successfully anywhere in Delaware, Maryland, and the Virginias, except perhaps at the greatest elevations. Early seeding is necessary to insure success, however, in the mountain sections and in Delaware. The bearded varieties are hardier than the beardless (hooded) ones, and only the former should be grown. Hooded or beardless barley is often highly recommended in this section, particularly for hay and pasture, but it is not a safe crop to grow from fall seeding. Tennessee Winter and other similar bearded varieties make excellent fall and spring pasture, but they are somewhat objectionable for hay because of the long, stiff beards.

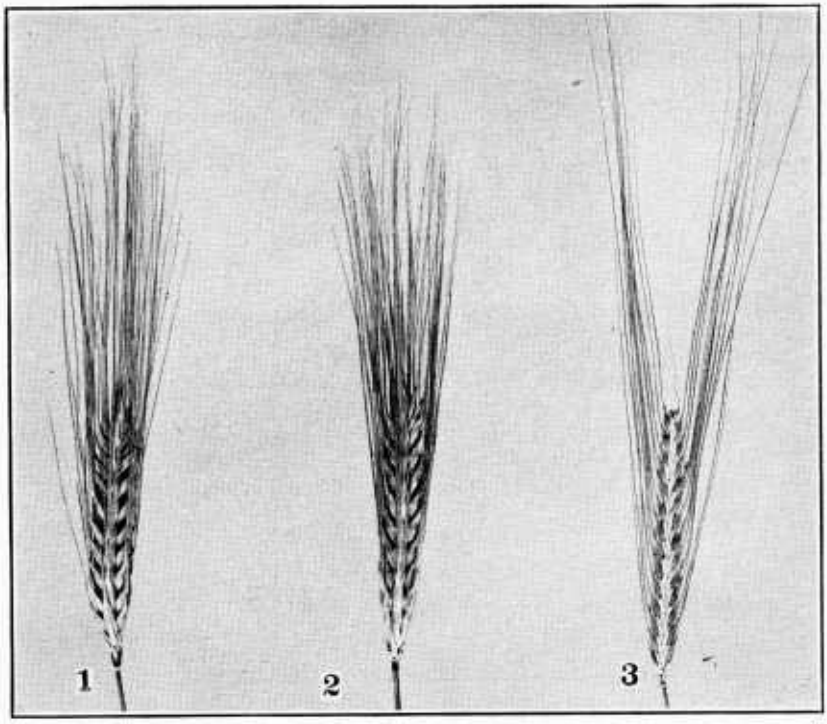

FIG. 5.—Heads of three varieties of winter barley grown at Arlington Experiment Farm: 1, Tennessee Winter; 2, Wisconsin Winter; 3, Omar

COMPARATIVE RETURNS

The comparative returns from the various small-grain crops are of vital interest in determining which one to grow. As an indicator of the relative value of these crops in Delaware, Maryland, Virginia, and West Virginia the average yield per acre of each crop in each State for the 10-year pre-war period from 1906 to 1915, inclusive, is presented in Table 2. The yields are given both in bushels and in pounds. The acre value of each crop is also given. These values are figured on the average acre yields and average farm price per bushel in each State, as reported by the Bureau of Agricultural Economics, United States Department of Agriculture.

TABLE 2.—*Average yields and farm values of wheat, rye, oats, and barley in Delaware, Maryland, Virginia, and West Virginia for the 10-year period 1906 to 1915, inclusive*

State	Yield per acre (bushels)				Yield per acre (pounds)				Value per acre			
	Wheat	Rye	Oats	Barley	Wheat	Rye	Oats	Barley	Wheat	Rye	Oats	Barley
Delaware	16.7	15.2	29.5	------	1,002	851	944	------	$15.86	$8.51	$14.16	------
Maryland	16.5	15.4	28.0	30.3	990	862	896	1,454	15.67	8.62	13.44	$18.79
Virginia	12.6	13.0	20.2	27.2	756	728	646	1,306	12.60	7.28	10.50	19.04
West Virginia	13.2	13.0	22.9	------	792	728	733	------	13.46	7.28	11.68	------

As shown in Table 2, wheat ranks highest in pounds of grain produced and in acre value of the crop in Delaware and in West Virginia. In Maryland and Virginia it is considerably exceeded in both respects by barley, a crop which is grown on only a small acreage and is not reported at all for the other two States. Oats rank next to wheat in value in every State, rye being lowest in every case. The acre yield of rye in Virginia is higher than that of oats, but is lower in the other States.

The figures for oats and barley in Table 2 are not entirely comparable with those for wheat and rye, for no separation is made by the Bureau of Agricultural Economics of the spring-sown and fall-sown crops. The wheat and rye in these States are practically all fall sown, whereas much of the oats and some of the barley are spring sown, particularly in Maryland and West Virginia.

A more reliable basis of comparison for the various crops in the Piedmont and Coastal Plain sections is afforded by the average yields obtained at the Arlington Experiment Farm, Va., and at College Park, Md. Yields and values of the highest yielding varieties of each crop are shown in Table 3. The yields at each place are all for the same period of years and all the grains were grown under very similar conditions. All were sown in the fall.

TABLE 3.—*Average acre yields and acre values of the highest yielding varieties of the various fall-sown grains at the Arlington Experiment Farm, Va., and at College Park, Md., for stated years*

Place, period, and crop	Yield per acre		Value per acre
	Bushels	Pounds	
Arlington, 5-year period, 1911 to 1915, inclusive:			
Purplestraw wheat	33.45	2,007	$34.11
Alstroum spelt	68.88	2,066	------
Giant Winter rye	34.25	1,918	29.99
Winter Turf oats	47.53	1,521	26.14
Tennessee Winter barley	27.57	1,323	20.61
College Park, 6-year period, 1909 to 1914, inclusive:			
Bearded Purplestraw wheat	30.62	1,837	29.62
Alstroum spelt	63.23	1,897	------
Winter Turf oats	49.30	1,578	23.78
Mammoth Winter barley	34.99	1,679	22.81

According to Table 3, the highest yield of grain in pounds at each place was produced by Alstroum spelt. As this grain is not commonly grown, however, and is not readily marketable, it is not pos-

sible to compare it with the other crops in acre value. Because of its high yield it should be a valuable grain to grow on farms where it can be fed to livestock. At Arlington, rye has yielded only slightly less than wheat and ranks next to it in acre value. This crop was not included in the tests at College Park. Oats and barley rank considerably below wheat in both yield and value, oats exceeding barley in value at both farms.

According to the figures here presented, wheat is the most profitable of the fall-sown grain crops in this section, rye, oats, and barley following in order. The high yields obtained from rye at Arlington are evidence of the ability of that crop to yield profitable returns when sown reasonably early on fertile, well-prepared land. The low yields of rye commonly obtained are due to the fact that the crop is usually sown very late and on poor soil.

The yields of the various crops on the two experiment farms are double or more than double the average yields in Maryland and Virginia, as reported by the Bureau of Agricultural Economics. This is an indication that the average yields can be materially increased if only the best varieties are grown and proper attention is given to the preparation of the land, its fertility, and the time and rate of seeding.

SUMMARY

The essentials for the profitable production of fall-sown grains in Delaware, Maryland, and the Virginias may be summarized briefly as follows: A well-drained soil; proper fertilization; a good system of crop rotation; a well-prepared seed bed; good, pure, cleaned, and graded seed which has been treated for smut; seeding at the proper time and rate; and growing adapted, high-yielding varieties. The best varieties for these States are the following:

WHEAT

Bearded varieties:
- Dietz.
- Fulcaster.
- Mammoth Red.
- Pennsylvania No. 44.
- Stoner.

Beardless varieties:
- China.
- Currell (Currell Prolific).
- Fulhio.
- Fultz.
- Leap (Leap Prolific).
- Poole.
- Potomac.
- Purplestraw.

RYE

- Abruzzes.
- Giant Winter.
- Von Rümker No. 2.

SPELT

- Alstroum.
- Red Awnless.

OATS

- Culberson.
- Fulghum.
- Lee.
- Tech.
- Winter Turf.

BARLEY

- Han River.
- Pidor.
- Tennessee Winter.
- Wisconsin Winter.

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